Environmental Modeling

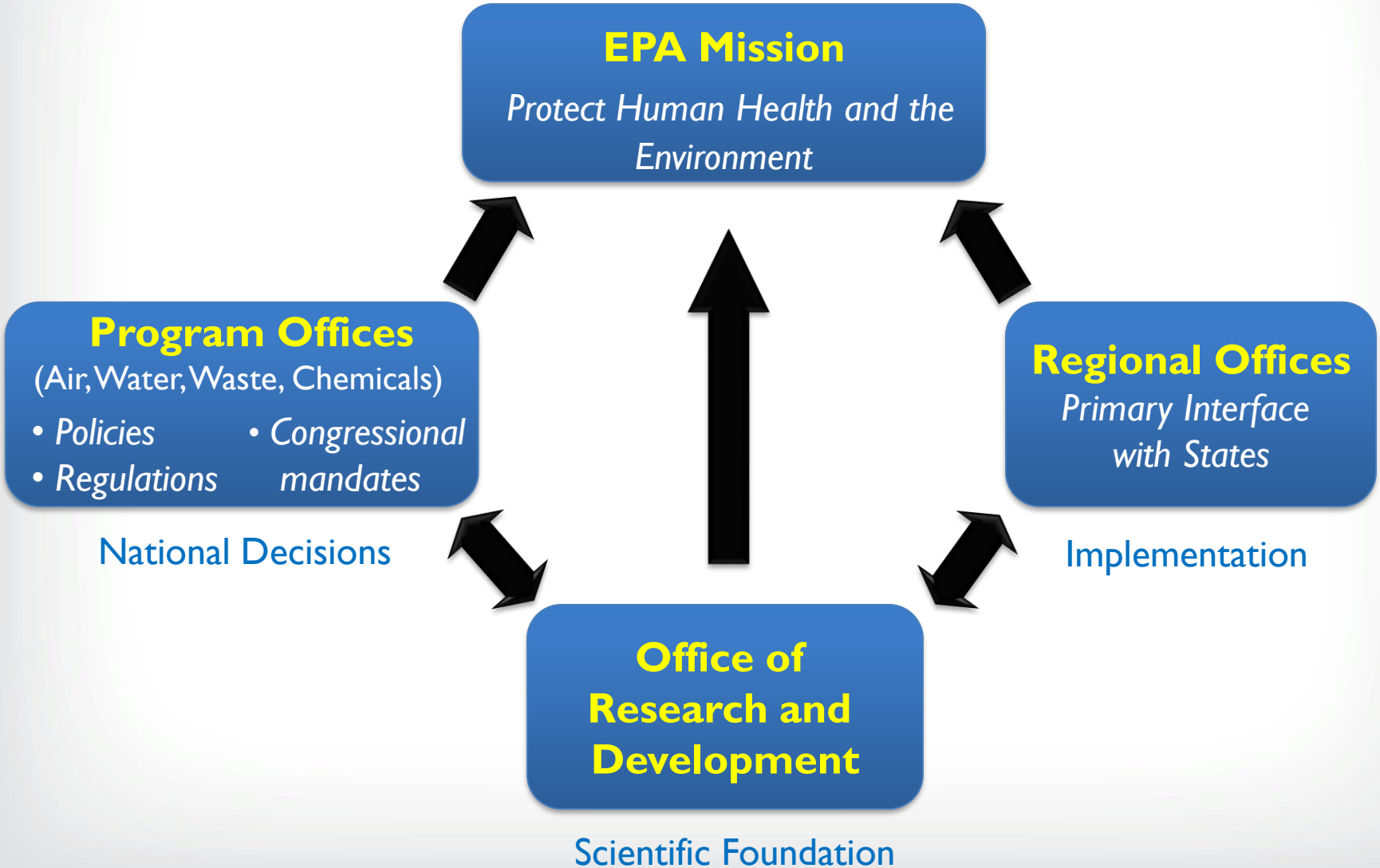
U.S. EPA's Office of Research and Development

Provide science and technology to support EPA's mission of protecting human health and the environment.

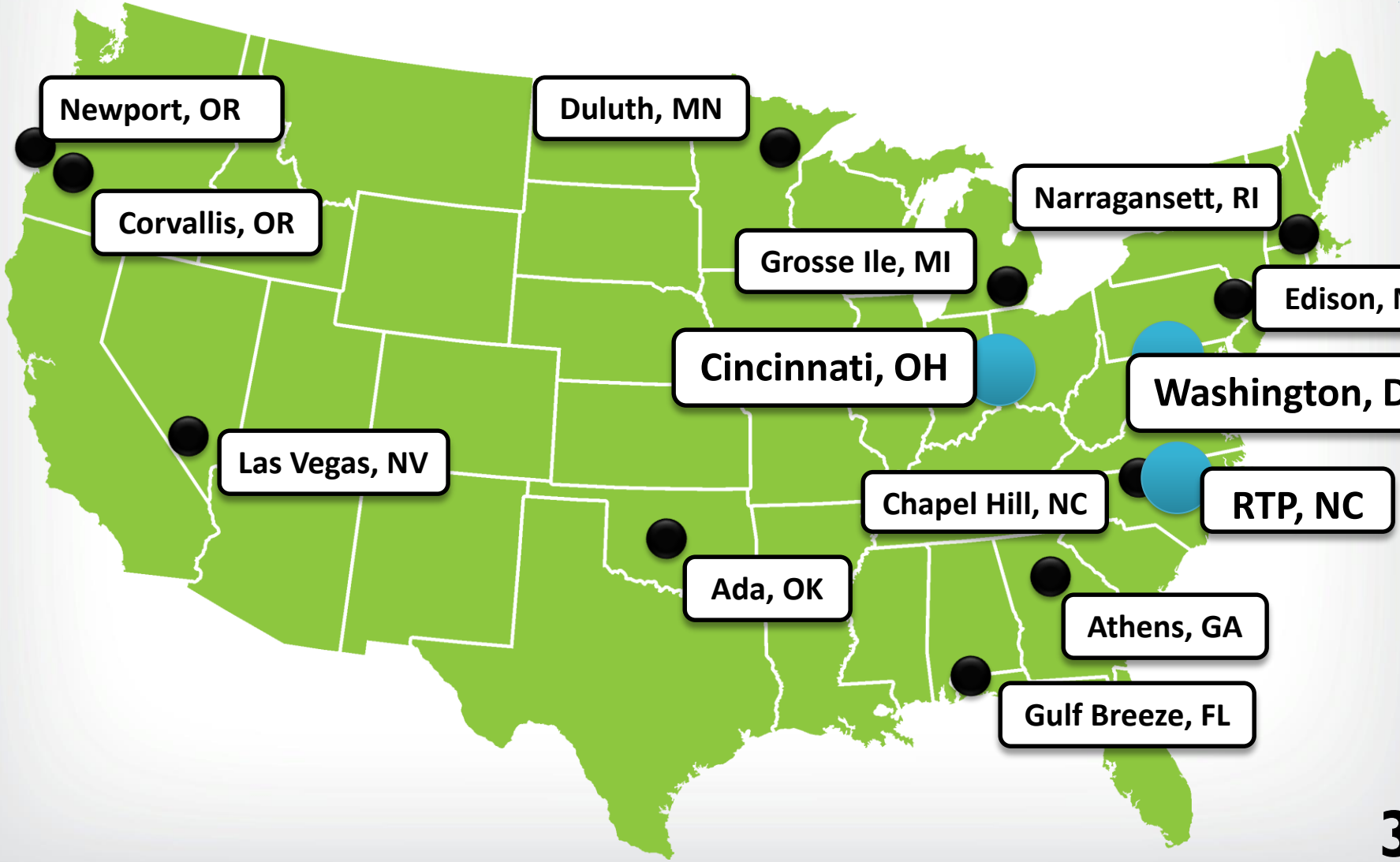
https://www.epa.gov/research/methods-models-tools-and-databases

https://www.epa.gov/aboutepa/about-office-research-and-development-ord

Science to Support EPA's Mission



ORD Research Facilities



Strategic Goals and Research Programs

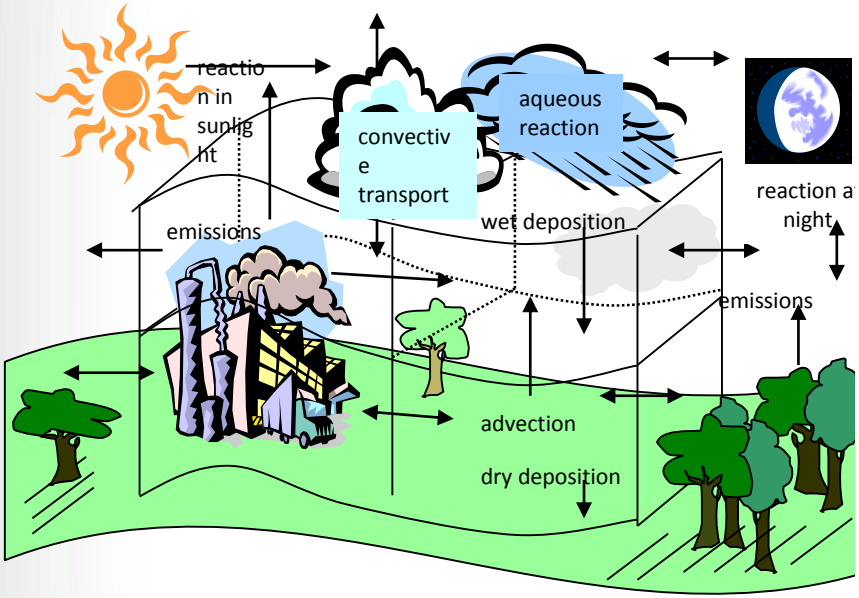
EPA Goals 2014-2018

- Addressing Climate Change and Improving Air Quality
- Protecting America's Waters
- Ensuring the Safety of Chemicals and Preventing Pollution
- Cleaning Up Communities and Advancing Sustainable Development
- Enforcing Laws, Ensuring Compliance

Research Programs

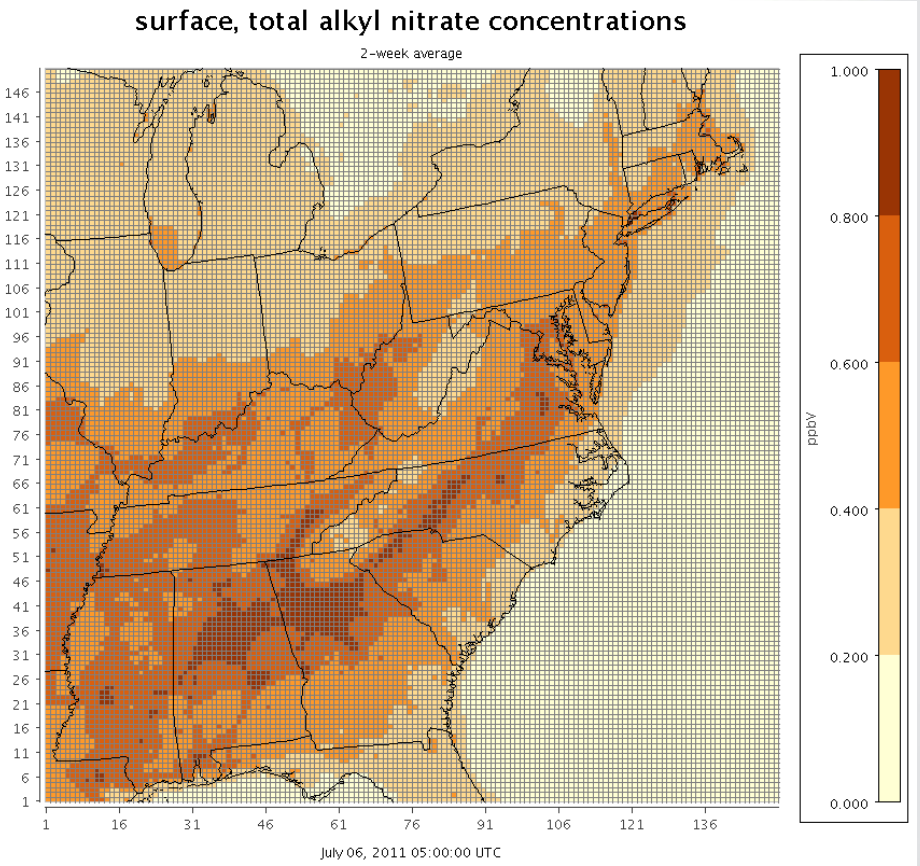
- Air, Climate & Energy
- Safe and Sustainable Water Resources
- Chemical Safety for Sustainability
- Sustainable and Healthy Communities
- Human Health Risk Assessment
- Homeland Security

Community Multi-Scale Air Quality Model (CMAQ)



Multiple processes control air pollutant concentrations that vary by hour, location, day and pollutant

Example CMAQ output



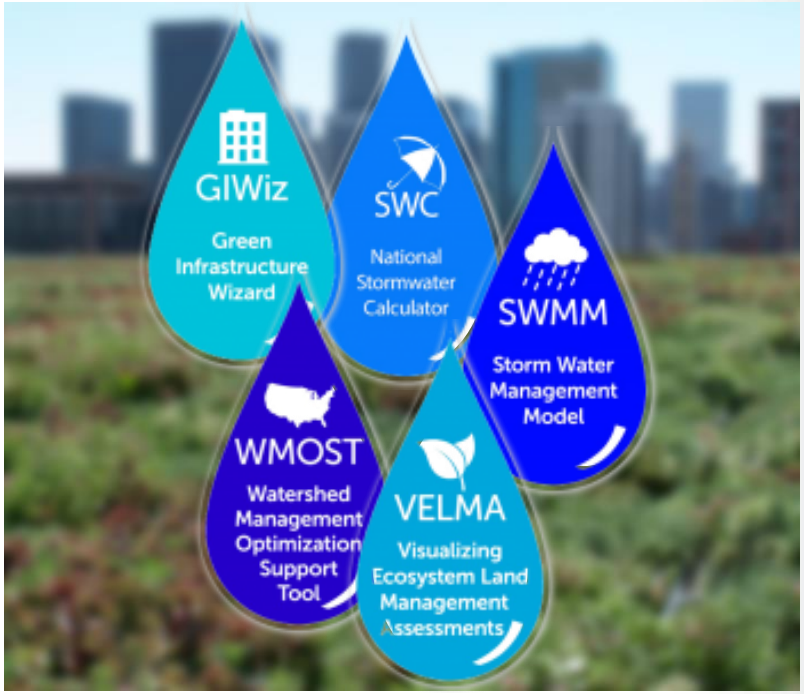
Watershed Models

Green Infrastructure Modeling Toolkit

epa.gov/water-research/green-infrastructure-modeling-toolkit

HAWQS

Hydrologic and Water Quality System – A National Watershed and Water Quality Assessment Tool



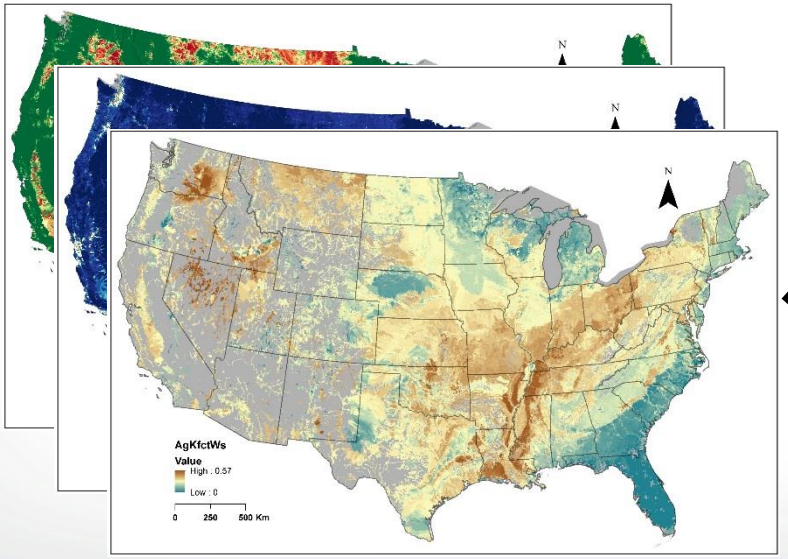
News Releases from Region 06

EPA awards $3.9M to University of Texas for Water Infrastructure Modeling Research Center

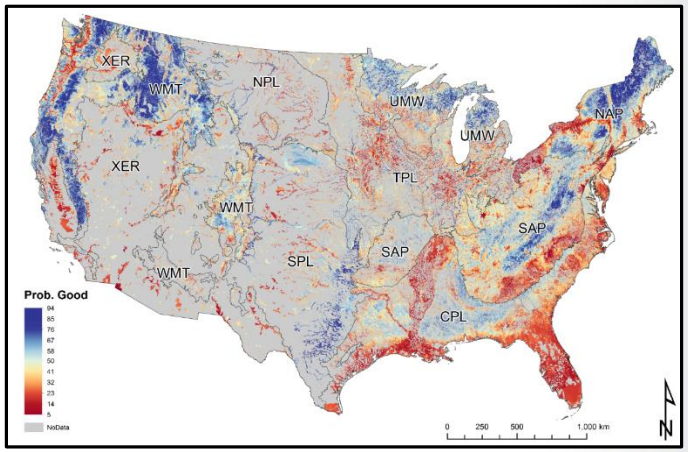
11/02/2016

Watershed Tools

National Aquatic Resource Survey (NARS) Data

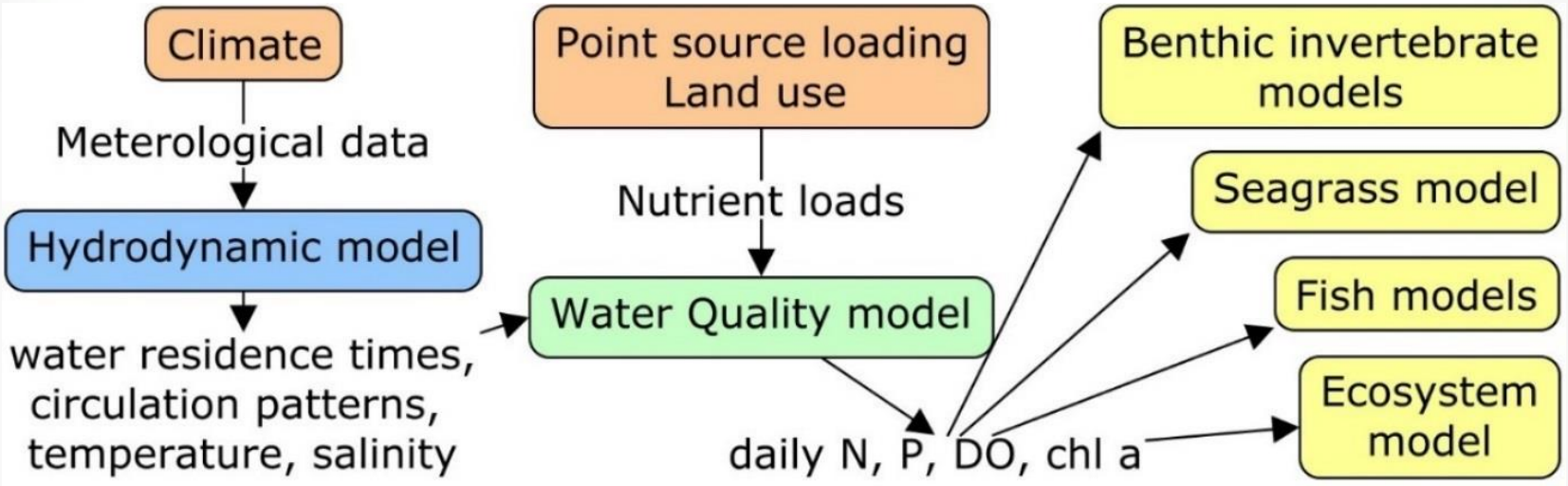


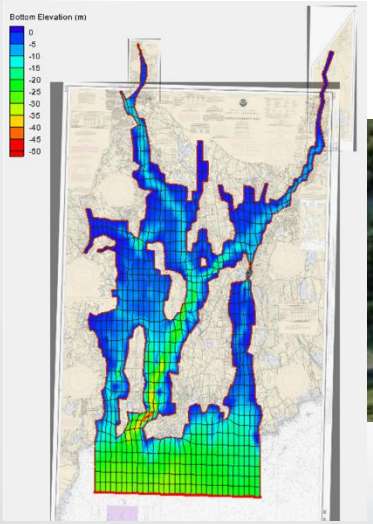
StreamCat Characterization



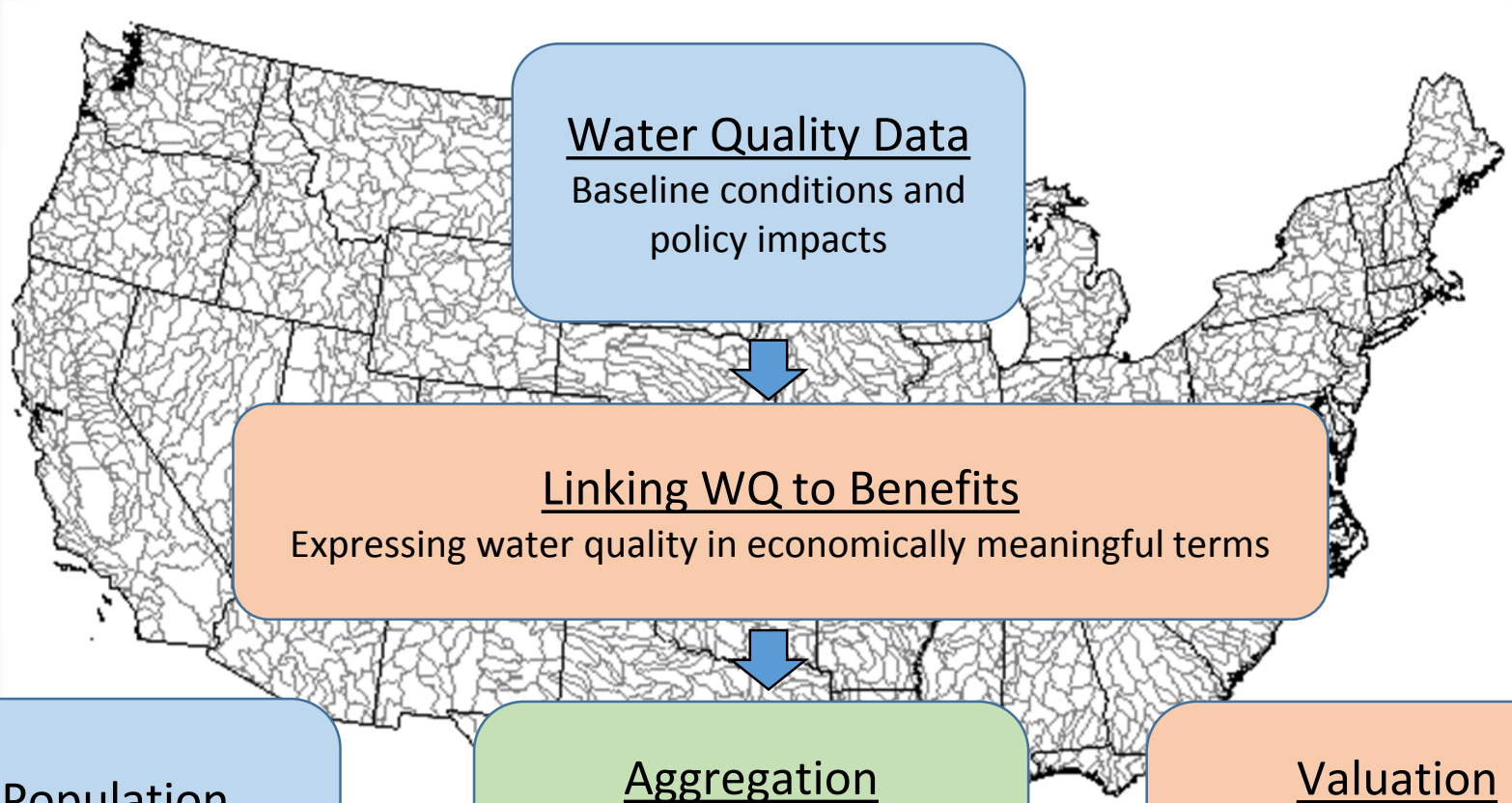
Model-based condition (everywhere)

Water Quality Models





Water Quality Benefits Platform



Water Quality Data
Baseline conditions and policy impacts

Linking WQ to Benefits
Expressing water quality in economically meaningful terms

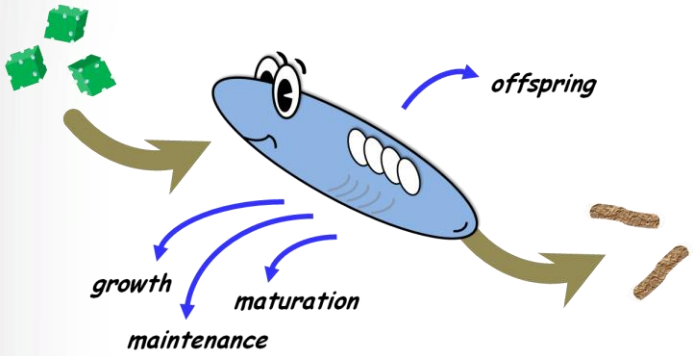
Population
Spatial distribution and demographic data

Aggregation
Combining valuation model and population data to estimate total benefits

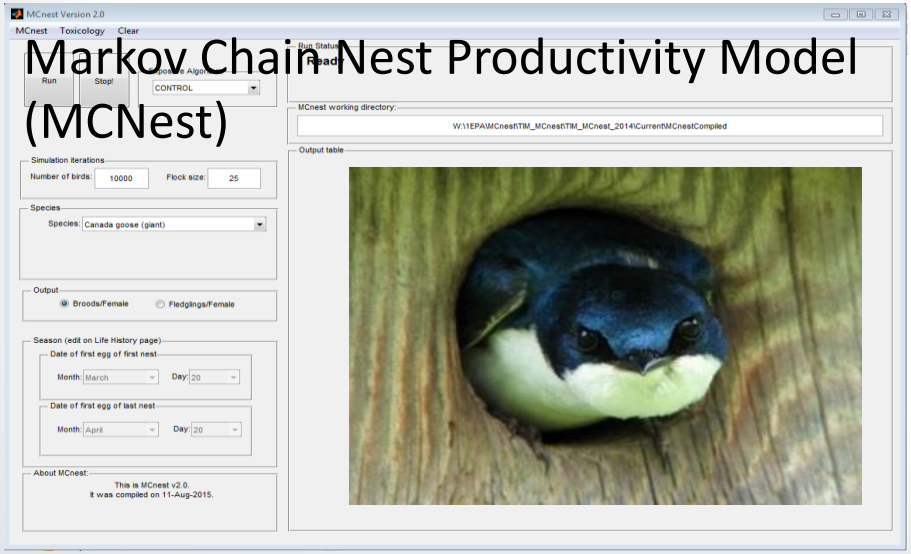
Valuation
Hedonics
Recreation Demand
Stated Preference

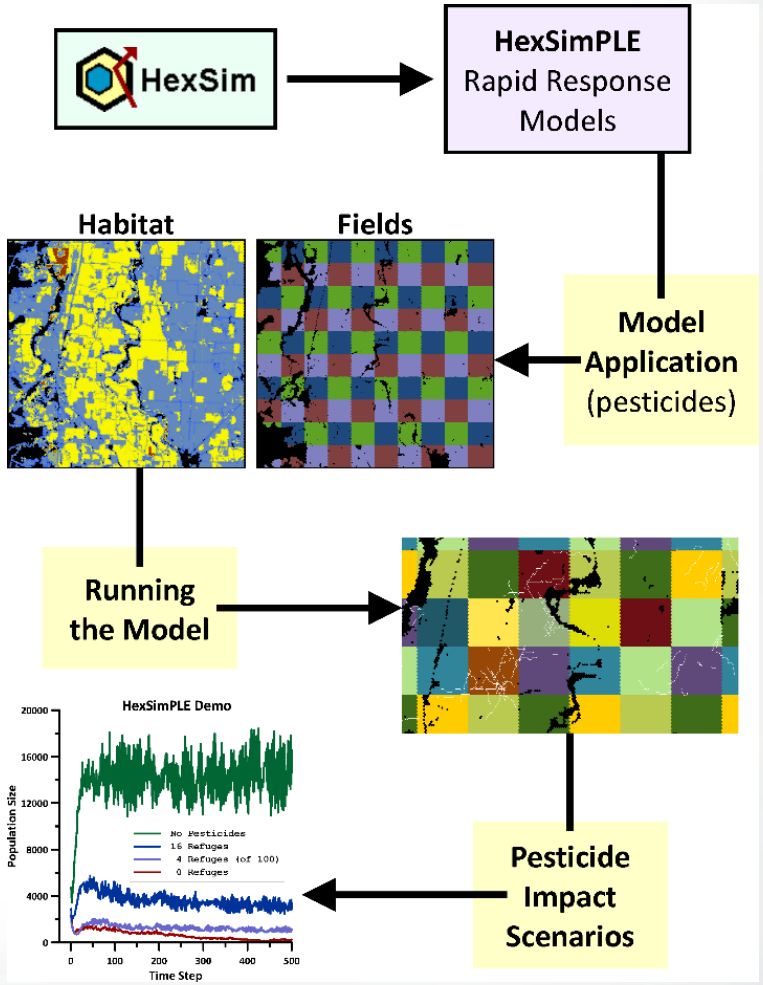
Population Models for Chemical Risk Assessment

Dynamic Energy Budget (DEB)

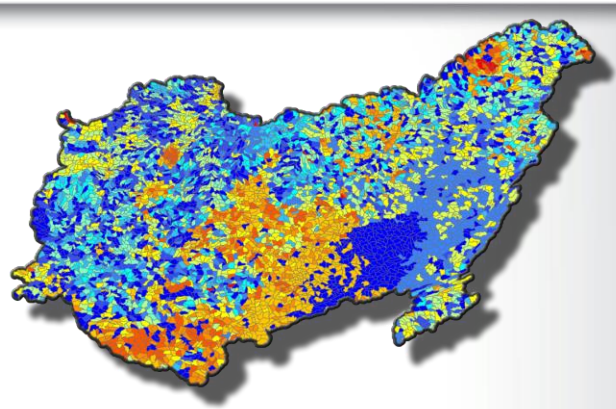


Markov Chain Nest Productivity Model (MCNest)





Modernizing Existing EPA Pesticide Models



- Map Reduce

  Count # times conc > threshold (0.1 µg/L)

  L = [0, 0, 0.1, **0.24**, **0.35**, **0.2**, **0.12**, 0.04, 0,

```
map(lambda x: True if x > 0.1 else False, L)
```

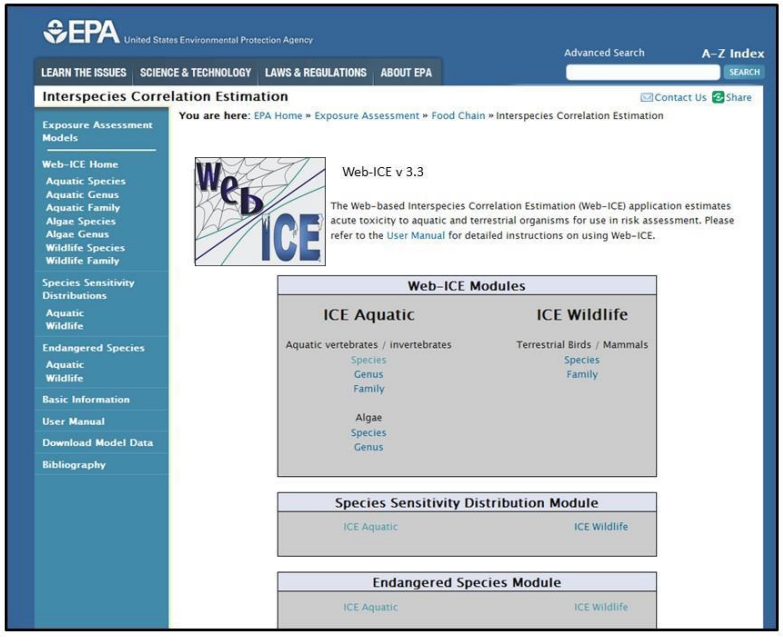
  Map = [F, F, F, **T**, **T**, **T**, **T**, F, F, F]

```
reduce(lambda x, y: x + y, Map)
```
  Reduce = 4

- Parallelization
- Cloud optimization to meet computing needs

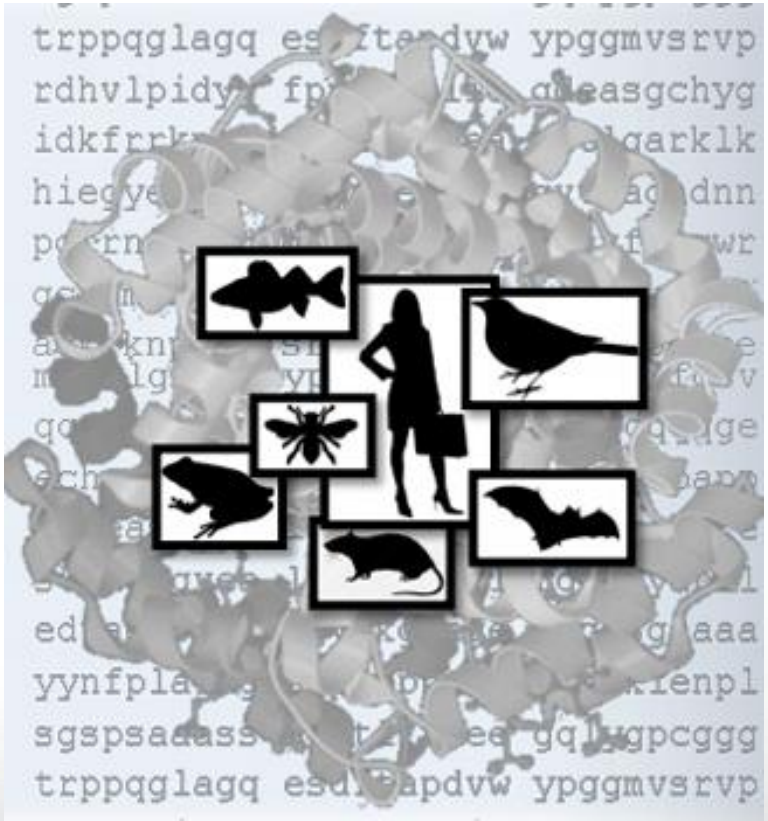
Chemical Tools

Interspecies Correlation Estimation (Web-ICE) V3.3 –release June 2016



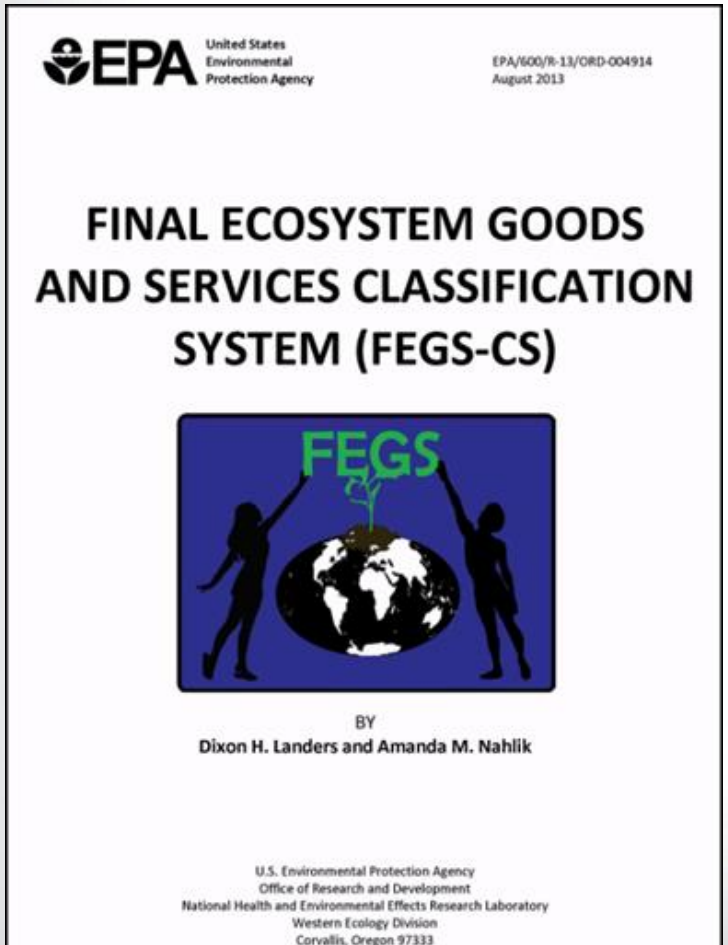
Estimates the acute toxicity of a chemical to a taxa from the known toxicity to a surrogate species

SeqAPASS: Sequence alignment to predict across-species susceptibility



Ecosystem Services

Δ Stressor → Δ Ecosystems → Δ Human Well-Being

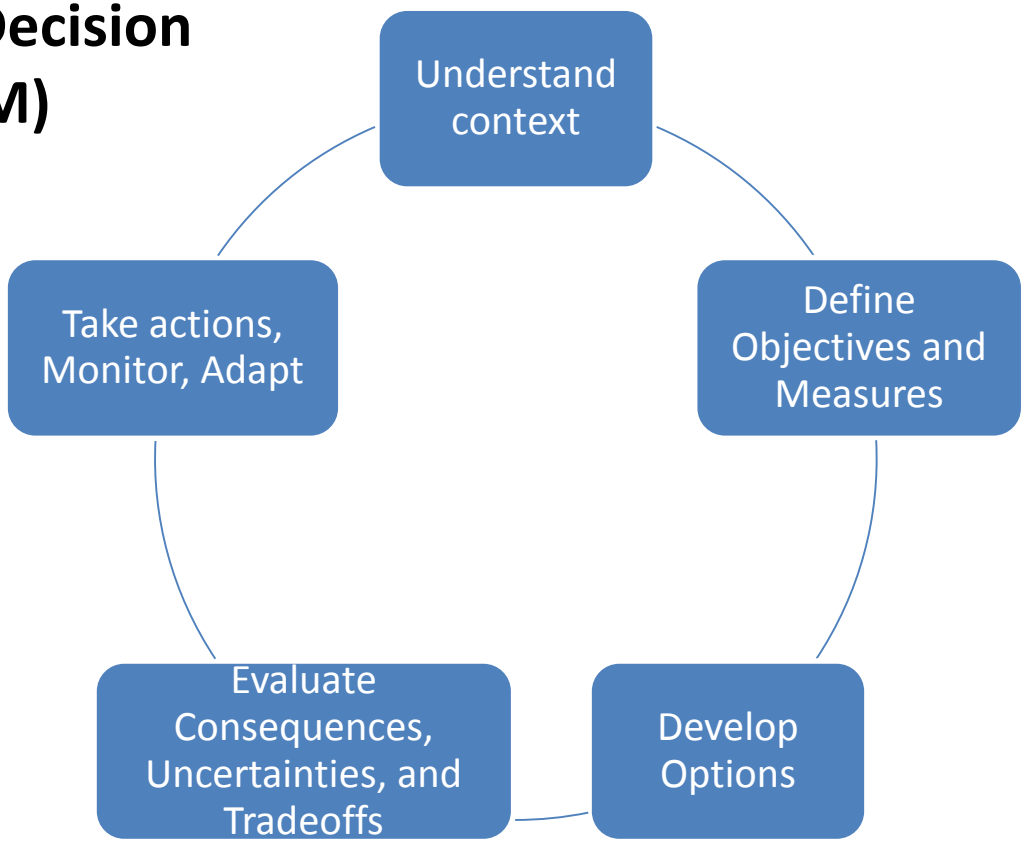


- Formalize and standardize a list of beneficiaries
- Provides an architecture to house metrics and indicators

https://www.epa.gov/eco-research/final-ecosystem-goods-and-services-classification-system

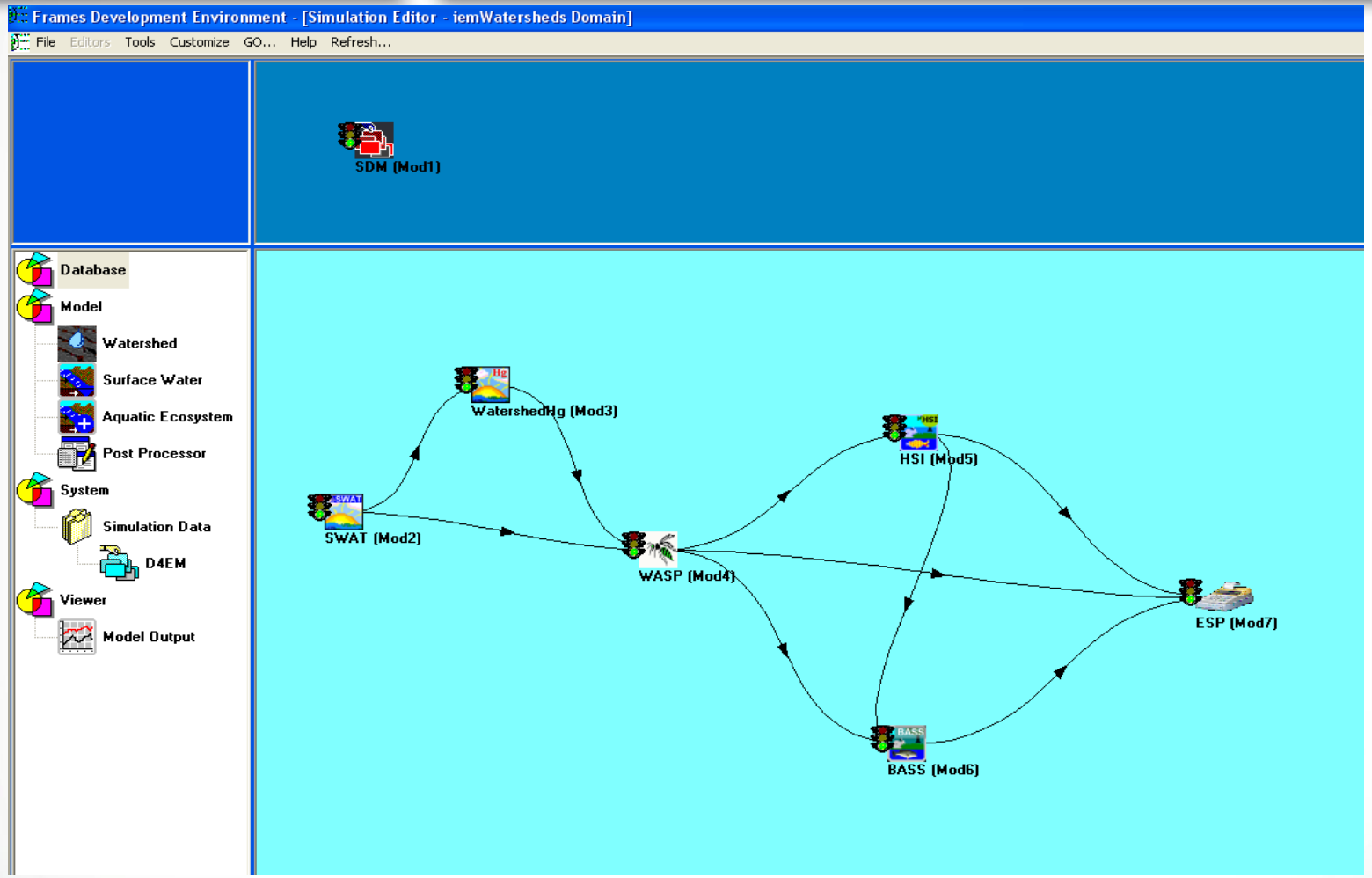
Decision Support for Communities

Structured Decision Making (SDM)



A formalization of common sense for decision problems that are too complex for informal use of common sense

Model Frameworks



- Infrastructure for integrated modeling workflows
- Standards for interoperability (automated data exchange)
- Utilities for uncertainty analysis, data acquisition, information synthesis, data visualization, etc.

Thank you, Questions?
Rashleigh.Brenda@epa.gov